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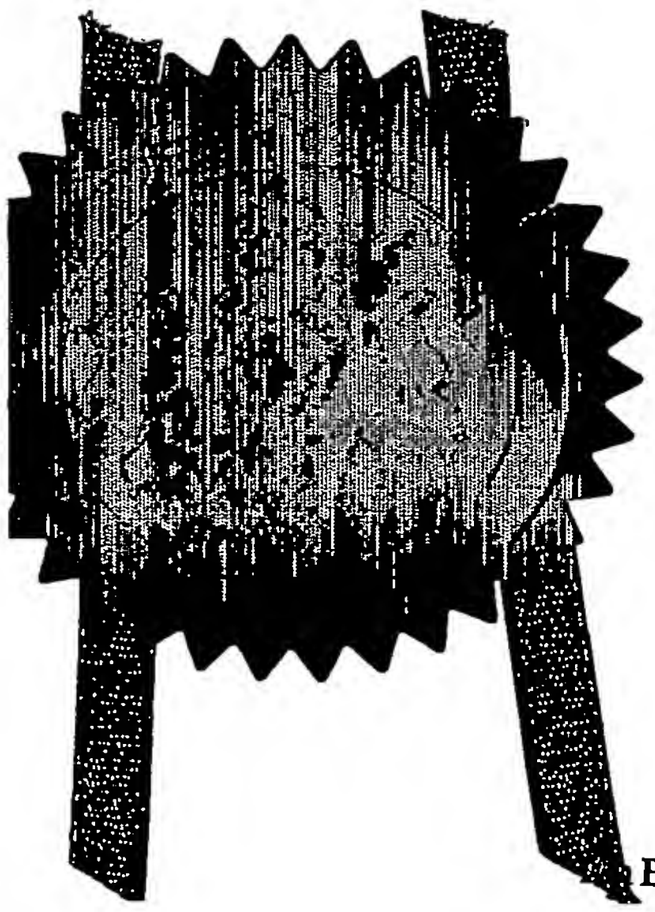

Signed Andrew Gerry

Dated 14 July 2004

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Cardiff Road
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NP10 8QQ

1. Your reference — 9650 GB JEB/VSB

2. Patent application number
(The Patent Office will fill in this part) — 01 JUL 2003 — 0315383.0

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

International Technology Traders Limited
Unit 17 Village Farm Road
Village Farm Industrial Estate
Pyle
Mid-Glamorgan
CF33 6BL

08665036 001
Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention — ORGANIC WASTE DISPOSAL

5. Name of your agent *(if you have one)* — Abel & Imray

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

20 Red Lion Street
London
WC1R 4PQ
United Kingdom

Patents ADP number *(if you know it)* — 174001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

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Continuation sheets of this form	
Description	13
Claim *(s)*	3
Abstract	
Drawing *(s)*	3 1 3

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Priority documents	
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this applicatio

Signature Abel and Imray Date 1/7/03

Abel & Imray 1 July 2003

12. Name and daytime telephone number of person to contact in the United Kingdom — Victoria Bradford - 020 7242 9984

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ORGANIC WASTE DISPOSAL

The present invention relates to organic waste disposal. In particular, the present invention relates to a method and apparatus for organic waste disposal which converts wet organic waste into a powder.

The term "organic waste" is used throughout to mean waste which is predominantly food waste (animal and vegetable waste, cooked or raw) but may include, for example, paper waste, effluent screenings or effluent sludge and may also include a small amount of non-organic packaging (for example foil or plastic). In order for the waste to be termed organic waste, the proportion of packaging must be low (in general, less than 10% by weight of non renewable materials such as plastics and foils). Other waste, which includes a higher proportion of non-organic waste, is often termed general waste or municipal solid waste (MSW). Organic waste typically has a significantly higher water content than MSW.

MSW may be easily disposed of by burning but organic waste, typically having a water content of more than 40%, can be combusted or gasified more easily after drying. Without drying, such combustion requires high temperatures. This requires the addition of dried material or fuel which reduces the moisture content and allows combustion at a high temperature or gasification. However, a number of methods of disposing of organic waste are known. Such known methods include disposing in landfill sites, as animal feed, by rendering (particularly meat waste and animal by-

products), by composting or by digestion (particularly slurries).

However, several such methods of organic waste disposal are becoming less acceptable for a number of reasons. Firstly, there is concern over the environmental impact of waste disposal. It is not known whether landfill sites are having long term detrimental effects on the environment and, as the amount of waste increases, more and more landfill sites are required. There are increased legislation and planning restrictions limiting new sites, particularly those for disposal of food waste. In addition, there is concern over the potential dangers of feeding food waste to livestock.

There is also increasing pressure on industry to take responsibility for their own waste. This means that there are fewer routes available to industry to dispose of their waste safely and that waste disposal is becoming a more and more costly business.

One known system for disposal of organic waste is illustrated in Figure 1, which shows a known process vessel 10 in cross-section. The vessel comprises four channels 12. Each channel 12 has a cross section which is a segment of a circle. Typically, the arc of the circle, which forms the curved wall of the channel extends about an obtuse angle, typically around 150° of the circle. However, the angle could be 180°, so that the cross section is semi-circular or could be greater than 180° or less than 90° depending on the application. The vessel could comprise fewer or more channels and this will depend on the space available and

the amount of organic waste to be processed. Each channel 12 includes an axle 16 which rotates, each axle 16 mounting a number of paddles (not shown) or one or more helical blades (not shown), sometimes known as a ribbon mixer. The channels are heated via a heat exchanger 14, so that the curved portions of each channel reach a high temperature (150°C to 250°C in some applications).

The organic waste is deposited into the channels 12 and, as the paddles or blades rotate and the channel walls heat up, the physical structure of the organic waste is broken down which assists the process of removing water by evaporation. After a certain amount of time, the organic waste is entirely converted to dry organic particles and fibres as well as shreds of the non-organic packaging. The material is then in the form of a powder or sand like material, which can be used as a fuel. This "bio-fuel" can be used in a number of applications.

This system avoids the need for landfill sites as well as avoiding the potential dangers associated with feeding food waste to livestock. However, there are several problems with known organic waste disposal systems which convert wet organic waste to a powder fuel.

In a known system, such as is illustrated in Figure 1, as the organic waste is dried to a bio-fuel in the process vessel, it passes through a number of phases. In the first phase, the organic waste has a high percentage water content. The organic waste can be heated extensively in this phase since the heat will result in water evaporation.

The application of physical force and abrasion together with the heat leads to water evaporation and the organic waste is broken down and dried out. The waste becomes a wet liquid/solid mix or a wet paste-like material. In the second phase, the waste is in the form of a thick paste. Because the paste is thick, the mixing machinery must be very robust in order to move through it and the vessel itself must be a strong structure. In addition, because the paste has a lower water content but is still in paste form, it cannot be too highly heated. The consistency of the paste means that it is difficult for the water to evaporate. Therefore, in order to dry the paste out, the paste must be heated gently so that the paste does not burn. As the water is removed, the thick paste breaks up and in the third phase, the organic waste is in powder form. In the third phase, the high surface area of the powder allows the water to evaporate easily and rapidly. The combination of the ease of mixing the powder and the relatively low water content, means that the powder can be raised to a high temperature and, just as in the first phase, there is a large amount of evaporation. The final result is powder bio-fuel.

In the second phase, the waste is in the form of a thick paste. The paste takes a long period of time to dry out to the powder form, because water evaporation is relatively difficult. The paste must be heated quite gently over a long period and this stage of the overall process is relatively inefficient. The consistency of the paste also means that the mixing machinery must be extremely robust. In addition, as the volume of the mixing vessel increases,

the forces on the mixers increase so the components are required to be stronger and stronger as the useful capacity of the vessel increases. This increases the cost of components. In addition, with this thick paste (sometimes termed "compacted paste"), there is an increased likelihood that the waste will clog the machinery.

An object of the present invention is to provide a method and apparatus for processing organic waste which avoids or mitigates the above-mentioned problem with known organic waste processors.

According to the invention, there is provided a method for drying organic waste, comprising the steps of:

mixing and heating the organic waste to form an organic paste; then

adding the organic paste to a first organic powder to form a mixture and mixing and heating the mixture,

wherein the rate of addition of the organic paste to the first organic powder is such that the resulting mixture is substantially in powder form.

The mixing and heating of the mixture may be performed simultaneously with the adding of the organic paste. Alternatively, the mixing and heating may be performed after each addition of organic paste.

By using such a two-stage process, the thick paste phase of the drying process can be substantially avoided. This means that the heating does not have to be so carefully controlled, the machinery does not have to be so robust and

the time taken for the entire drying process (from original organic waste to powder bio-fuel) can be reduced. Also, there is a reduced risk that the organic waste will compact and clog machinery. The organic paste is rapidly combined with the first organic powder and the resulting mixture remains substantially in powder form throughout the addition of the organic paste.

The original organic waste will typically have a water content of more than about 40% by weight. Of course, it is possible for the organic waste to have a water content of less than about 40% by weight. The water content of the organic waste will depend on the particular composition of the organic waste.

It should be noted that, throughout the specification, the water content percentages or other content percentages (e.g. non-organic packaging) always refer to percentage by weight.

Preferably the organic paste has a water content of between about 20% and about 30% by weight when it is added to the first organic powder. It is possible for the organic paste to have a higher water content when it is added to the first organic powder. In that case, the rate of addition of the organic paste to the first organic powder will need to be slower in order to maintain the resulting mixture in powder form. For example, the organic paste may have a water content of 40% by weight. Alternatively, it is possible for the organic paste to have a lower water content. In that case, the rate of addition of the organic

paste to the first organic powder can be faster. The objective is to reduce the moisture content of the organic paste to as low as possible without the risk of forming a compacted paste. At this point the organic paste is added to the first organic powder at a rate which is appropriate to reduce the risk that the resulting mixture forms an organic paste which may compact. Rather, the resulting mixture remains in powder form.

Preferably, the first organic powder is as dry as possible. As described, this reduces the risk that the mixture will form a paste. Preferably the first organic powder has a water content of less than about 10% by weight. It is possible for the first organic powder to have a higher water content. The exact water content will affect the rate of addition of the organic paste to the first organic powder.

In one embodiment, the method includes the further step of further mixing and heating the mixture to form a second organic powder. Such mixing and heating reduces the water content of the mixture still further, which is appropriate if the resulting second organic powder is to be used as a bio-fuel.

Preferably, the second organic powder has a water content of about 10% by weight. Ultimately, the water content will depend upon the method of conveying the organic powder as a bio-fuel, its storage and its input to energy conversion equipment. It has been found that, with a water content of about 10% by weight, the powder is useful as a bio-fuel

since the bio-fuel is physically stable, able to be transported as powder, compressed into briquettes, blown into cyclones and/or screw fed.

The resulting second organic powder can be used as a bio-fuel on site or stored and transported off site. Heat generated from burning can be used in a number of applications. For example, the heat may be used to generate electricity, hot water or steam or may be used for refrigeration.

The first organic powder may be formed separately on or off site. However, preferably the method comprises the preliminary step of drying organic waste to form the first organic powder. This preliminary step of drying organic waste to form the first organic powder may be done by mixing and heating the organic waste in either a known one-stage process or a two-stage process according to the invention.

According to the invention, there is also provided apparatus for drying organic waste comprising:

a first vessel for mixing and heating the organic waste to form an organic paste;

means for adding the organic paste to a first organic powder to form a mixture;

a second vessel for mixing and heating the mixture to form a second organic powder; and

means for controlling the rate of addition of the organic paste to the first organic powder, such that the resulting mixture is substantially in powder form.

The first and second vessels may be completely separate vessels or the second vessel may be a separated section of the first vessel.

As described above, the organic waste will typically have a water content of more than about 40% by weight but it is possible for the organic waste to have a water content of less than about 40% by weight.

Preferably the organic paste has a water content of between about 20% and about 30% by weight when it is added to the first organic powder but, as described above, it is possible for the organic paste to have a higher water content or a lower water content. As explained, the exact water content will affect the rate of addition of the organic paste to the first organic powder.

Preferably the first organic powder has a water content of less than about 10% by weight but, as described above, it is possible for the first organic powder to have a higher water content. The exact water content will affect the rate of addition of the organic paste to the first organic powder.

Preferably, the second organic powder has a water content of about 10% by weight. As described previously, it has been found that this percentage water content is advantageous if the second organic powder is to be used as a bio-fuel.

One or both of the first and second vessels may comprise:

at least two elongate channels, each channel having a length and a substantially segment shaped cross-section;

an axle associated with each channel, each axle mounted for rotation about an axis parallel to the length of its respective channel, each axle mounting a plurality of mixing paddles or one or more helical blades; and

a heater for heating the channels.

It is intended that any features described above in relation to the method of the invention may also be incorporated into the apparatus of the invention and that any features described above in relation to the apparatus of the invention may also be incorporated into the method of the invention.

An embodiment of the invention will now be described with reference to the accompanying drawings of which:

Figure 1 is a cross-sectional view of a known process vessel;

Figure 2 is a schematic diagram showing circulation of organic waste in a process vessel; and

Figure 3 is a schematic diagram of a heat exchanger.

In the known process vessel shown in Figure 1, the amount of organic waste which can be processed per unit time will depend, *inter alia*, on the number of channels, the dimensions of each channel, the type of organic waste, the

temperature of each channel and the speed of rotation of the axles.

In one embodiment, each channel is 3 m long, with a radius of 0.4 m. In that case, each channel can accommodate up to 1 tonne of organic waste so that the whole process vessel can accommodate 4 tonnes of organic waste.

Adjacent channels 12 have axles mounted to rotate in opposite directions. The construction of the paddles and the axles means that organic waste moves, for example, from the edges to the centre of the first channel, over the lip into the adjacent second channel, from the centre to the edges of the second channel, over the lip into the adjacent third channel and so on. Thus, the construction and rotation of the axles 16 and paddles 18 ensure that the organic waste circulates through the entire process vessel 10 as shown by schematic diagram Figure 2. Figure 2 shows a four-channel process vessel 10 but the circulation system could, of course, be applied to any number of channels 12. The efficient circulation means that the process vessel 10 can be used to full capacity, that the active heated surface area of the channels 12 is used as efficiently as possible and that the breakdown of all the organic waste occurs at a consistent speed throughout the volume of the organic waste i.e. it reduces the likelihood that some of the waste is completely broken down, while some remains close to its original un-broken down form.

As shown previously, the channels 12 are heated from beneath by a heat exchanger 14. A schematic diagram of the

heat exchanger of the present invention is shown in Figure 3, in a process vessel comprising eight channels 12. Hot gas is pumped into the heat exchanger 14 at inlet 26 and into the lower section of the heat exchanger, which acts as a pressure balancing chamber to assist in maintaining an even flow of hot air. The hot gas passes over the base of the heat exchanger 14, which is provided with insulation 28, and over the furthest edge of the heating jacket 30. The hot gas then passes over the heating jacket 30 in the upper section adjacent the semi-cylindrical channel surfaces and eventually out of the heat exchanger 14 at outlet 32. The heat exchanger 14 preferably provides an even heat transfer across the walls of the channels 12 so that there is a substantially uniform temperature distribution throughout the food channels.

According to the invention, the one-stage drying process is converted to a two-stage drying process, which reduces the problems associated with the thick paste phase of the drying organic waste. In a four-channel process vessel, the vessel can be easily adapted for the two-stage process by separating the second and third channels, so that the four-channel process vessel becomes two two-channel process vessels. This can be achieved by a simple mechanical weir, valve or similar control device. Of course, the process can be carried out in two separate vessels.

In the first and second channels, the organic waste is converted to a paste of about 20% to about 30% water. Once the thick paste phase is reached, the thick paste is added to already formed powder having a water content less than

about 10% in the third and fourth channels. The rate of addition is controlled such that the waste in the third and fourth channels remains substantially in powder form. The rate of addition will therefore depend, *inter alia*, on the type of organic waste, the exact water content of the thick paste and the powder, the temperature of the channels and the rotation speed of the paddles. This method quickly alters the added material to be dried, and allows the powder to be mixed with relatively little power. The two-stage process could, of course, be used in a process vessel with any number of channels.

It will be appreciated that any features described above in relation to the known one-stage process may also be incorporated into the two-stage process according to the invention.

CLAIMS

1. A method for drying organic waste, comprising the steps of:

mixing and heating the organic waste to form an organic paste; then

adding the organic paste to a first organic powder to form a mixture and mixing and heating the mixture,

wherein the rate of addition of the organic paste to the first organic powder is such that the resulting mixture is substantially in powder form.

2. A method according to claim 1 wherein the organic waste has a water content of more than about 40% by weight.

3. A method according to claim 1 or claim 2 wherein the organic paste has a water content of between about 20% and about 30% by weight.

4. A method according to any preceding claim wherein the first organic powder has a water content of less than about 10% by weight.

5. A method according to any preceding claim further comprising the step of further mixing and heating the mixture to form a second organic powder.

6. A method according to claim 5 wherein the second organic powder has a water content of about 10% by weight.

7. A method according to any preceding claim further comprising the preliminary step of drying organic waste to form the first organic powder.

8. A method according to claim 7 wherein the step of drying organic waste to form the first organic powder is done by mixing and heating the organic waste.

9. Apparatus for drying organic waste comprising:

a first vessel for mixing and heating the organic waste to form an organic paste;

means for adding the organic paste to a first organic powder to form a mixture;

a second vessel for mixing and heating the mixture to form a second organic powder; and

means for controlling the rate of addition of the organic paste to the first organic powder, such that the resulting mixture is substantially in powder form.

10. Apparatus according to claim 9 wherein the organic waste has a water content of more than about 40% by weight.

11. Apparatus according to claim 9 or claim 10 wherein the organic paste has a water content of between about 20% and about 30% by weight.

12. Apparatus according to any one of claims 9 to 11 wherein the first organic powder has a water content of less than about 10% by weight.

13. Apparatus according to any one of claims 9 to 12 wherein the second organic powder has a water content of about 10% by weight.

14. Apparatus according to any of claims 9 to 13 wherein the first vessel comprises

at least two elongate channels, each channel having a length and a substantially segment shaped cross-section;

an axle associated with each channel, each axle mounted for rotation about an axis parallel to the length of its respective channel, each axle mounting a plurality of mixing paddles or one or more helical blades; and

a heater for heating the channels.

15. Apparatus according to any one of claims 9 to 14 wherein the second vessel comprises

at least two elongate channels, each channel having a length and a substantially segment shaped cross-section;

an axle associated with each channel, each axle mounted for rotation about an axis parallel to the length of its respective channel, each axle mounting a plurality of mixing paddles or one or more helical blades; and

a heater for heating the channels.

16. Apparatus for drying organic waste according to the method of any one of claims 1 to 8.

FIGURE 1

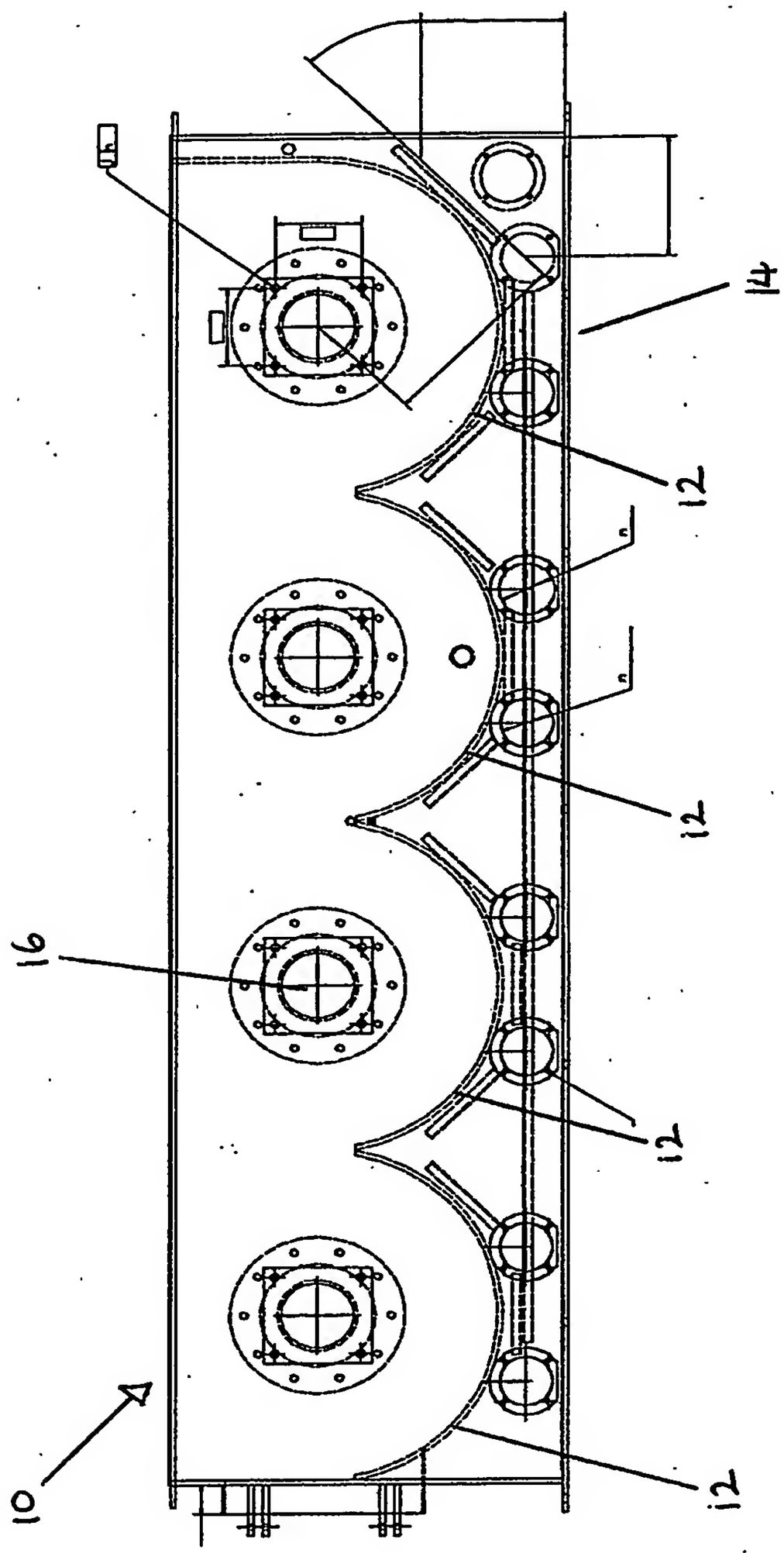

FIGURE 2

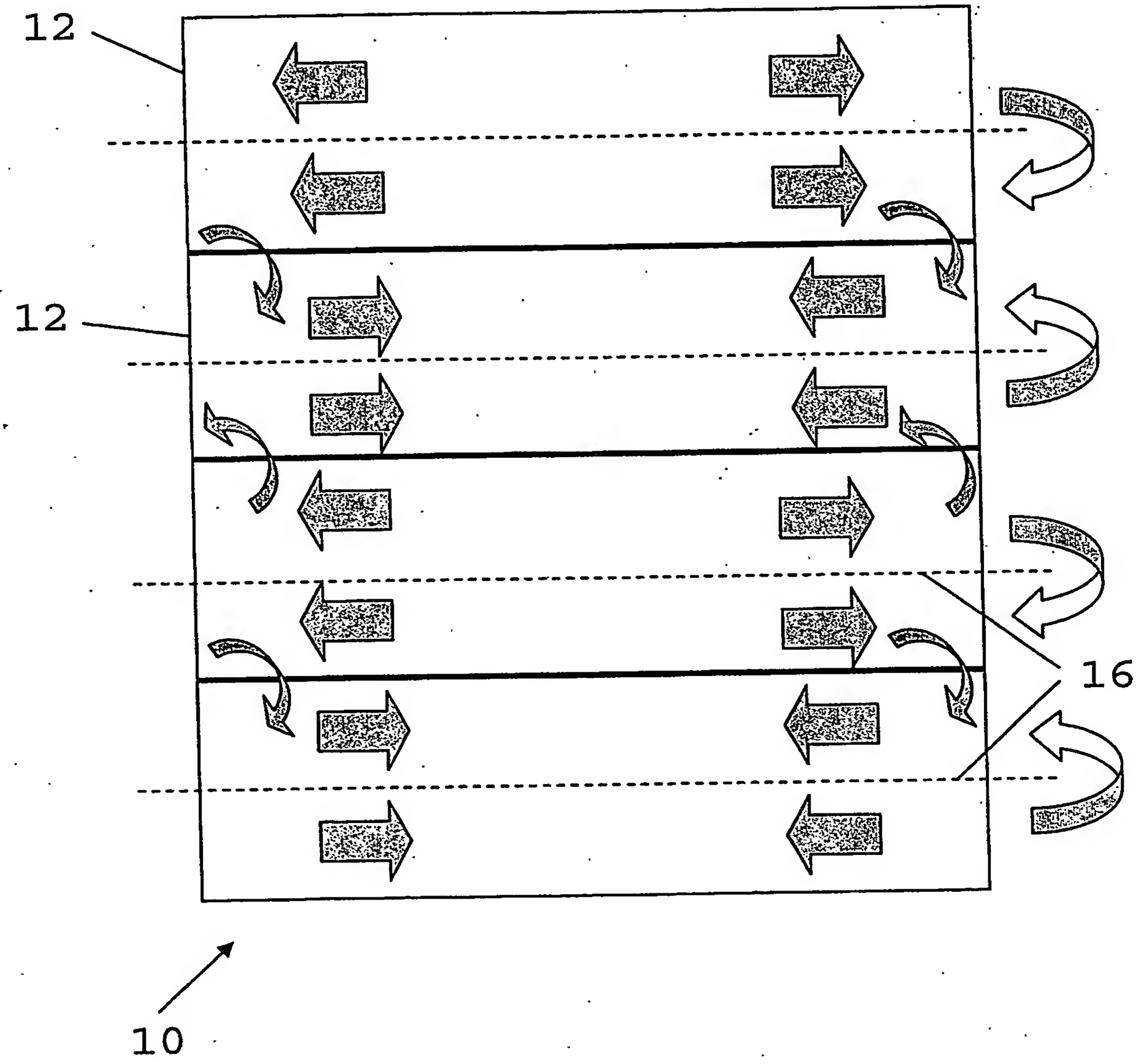

FIGURE 3